THE USE OF FRANCK-CONDON FACTORS FOR THE SO_2 $\tilde{C}$-$\tilde{X}$ ELECTRONIC TRANSITION TO MEASURE VIBRATIONAL RELAXATION IN A LASER-EXCITED SUPERSONIC EXPANSION FROM AN EVEN-LAVIE VALVE

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We are characterizing the vibrational relaxation dynamics of SO_2 in an Even-Lavie (EL) valve supersonic expansion. The EL valve provides rotational cooling to about 1 Kelvin with minimal clustering. In the expansion, the $\tilde{C}$ $^1B_2$ state of SO_2 is populated using laser excitation of a selected line of the $\tilde{C}$-$\tilde{X}$ electronic transition. The $\tilde{C}$ state rapidly fluoresces to the $\tilde{X}$ $^1A_1$ state with known Franck-Condon (FC) factors. SO_2 is rotationally cooled in the expansion, but vibrational cooling from the initial FC distribution is slower and depends on parameters of the supersonic expansion. Using chirped-pulse millimeter-wave spectroscopy, relative intensity measurements of selected rotational transitions and their ”vibrational satellites” can be performed. The observed change of the vibrational population distribution (VPD) from that of the FC distribution describes the vibrational cooling in the EL supersonic expansion. Comparing the observed VPDs with the calculated FC intensities, we characterize the relaxation dynamics as a function of various physical parameters, including the location in the expansion and the backing pressure. This experimental scheme will also be used to characterize relaxation dynamics in a cryogenic buffer gas beam. This knowledge of the nascent (unrelaxed) VPD can be used to study the transition states of photo-fragmentation reactions.